

RICE — FIELD WEEDS IN THE COLOMBO AND GAMPAHA DISTRICTS OF SRI LANKA

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Abstract : Two rice-growing districts in the low-country Wet Zone were surveyed for the weed-flora in the rice-fields. A comprehensive list of the species, including grass, sedge and broad-leaved weeds found in the rice-fields surveyed, is presented. An estimation of the frequency of occurrence of the major weeds was made in order to evaluate the abundance of the species in the rice agroecosystem. A method of scoring based on visual estimation of cover was used to evaluate the level of infestation of the weeds. *Imbristylis miliacea*, *Isachne globosa* and *Cyperus iria* were the most abundant monocotyledonous weed species found in the rice-fields of the two districts. Among the broad-leaved weeds, *Ludwigia hyssopifolia* was by far the most abundant species with high levels of infestation in most of the fields surveyed. A second species of *Ludwigia*, yet unidentified and probably a relatively new weed record for Sri Lanka, was also found to occur in high frequency in the Colombo district. The survey revealed that a rich weed-flora occurs, both within the rice-field habitat and on the raised earthen bunds in the areas studied.

1. Introduction

Rice-cultivation in Sri Lanka covers an area of about 0.53 million hectares and provides employment for a very large section of the peasantry in the country. Recent times have seen an encouraging and steady increase in rice production in the country. However, weed problems are one of the major factors depressing rice yields in many parts of the island.^{3,9} Total yield losses in rice due to weeds have been estimated at about 20%,⁹ but this figure is dependent on factors such as type of rice cultivar, time of cultivation, degree of available moisture in soil and the composition of the weed flora.

It has been reported that there are about 70–80 weed species which occur commonly as rice-field weeds,⁹ but that most of them cause little concern to the farmer. The number of species that comprise the major portion of the weed flora in any rice-field in the country may not exceed 10–15, out of which only 4–5 may be categorized as important to warrant control measures.⁹

Many of the rice-field weeds of Sri Lanka and their distribution^{6,8} and weeds found in arable soils which include many of the rice-field weeds

listed under wetland conditions,² have been already described. A more comprehensive survey of rice-field weeds in the island based on visits to 518 villages both in the Wet and Dry zones in 1975/1976 revealed that *Fimbristylis miliacea* (L.) Vahl, *Isachne globosa* (Thunb.) O.Ktze. and *Cyperus haspan* L. were the most serious rice-field weeds in the country.¹⁰

The present survey was carried out to update and improve the status of knowledge regarding rice-field weeds of Sri Lanka, in the Low Country Wet Zone. In addition to compiling a list of the species in accordance with the newly revised flora of the island,⁵ emphasis was placed on determining their frequency of occurrence and levels of infestation.

2. Materials and Methods

Two major rice-producing districts in the low-country Wet Zone, namely Colombo and Gampaha (Figure 1), were chosen for the present survey, which was carried out during the 'Yala' (April–August) season of 1984. The sampled rice fields were the same ones selected by the Department of Census and Statistics for their annual rice-yield estimations,⁷ done every season at District level. The Department of Census and Statistics uses a multi-stage stratified sampling frame for the purpose of selecting rice-fields for sampling.⁷ Villages are selected at random with probability proportional to the area under rice cultivation. In each selected village, two rice-fields are chosen at random and in each one, a 'Liyadde' (an area surrounded by elevated earthen banks) is also chosen at random. Rice-yield estimations are done by harvesting experimental plots of a standard size located within the selected 'liyaddes'.⁷ The present rice-weed survey was also done in the same randomly chosen fields and in many instances incorporating the 'liyaddes' selected for yield estimations by the Department of Census and Statistics. In each of the chosen rice-fields a minimum of 4 liyaddes was surveyed.

Each sample field was surveyed by walking along the bunds, collecting and identifying the weeds present and recording their occurrence. Quadrats of 0.5 m² were placed at random, a minimum of 4 times within a liyadde, to study the weeds that were occurring below the crop canopy. The weeds growing above the crop canopy were evaluated by scanning the whole field/liyadde. The bund-weed flora was also studied using the quadrats. The relative abundance of each species was scored using the following key: 0 = weed species not observed; 1 = a few scattered plants; 2 = occasional patches of the weed; 3 = weed widespread throughout field (or bund); 4 = a dense infestation, and 5 = weed completely dominating and masking the crop (or other on bunds). Categories 2, 3, 4 and 5 corresponded approximately with 1–25% weed cover, 26–50% weed cover, 51–75% weed cover and 76–100% weed cover, respectively, based on visual estimates. Whilst the

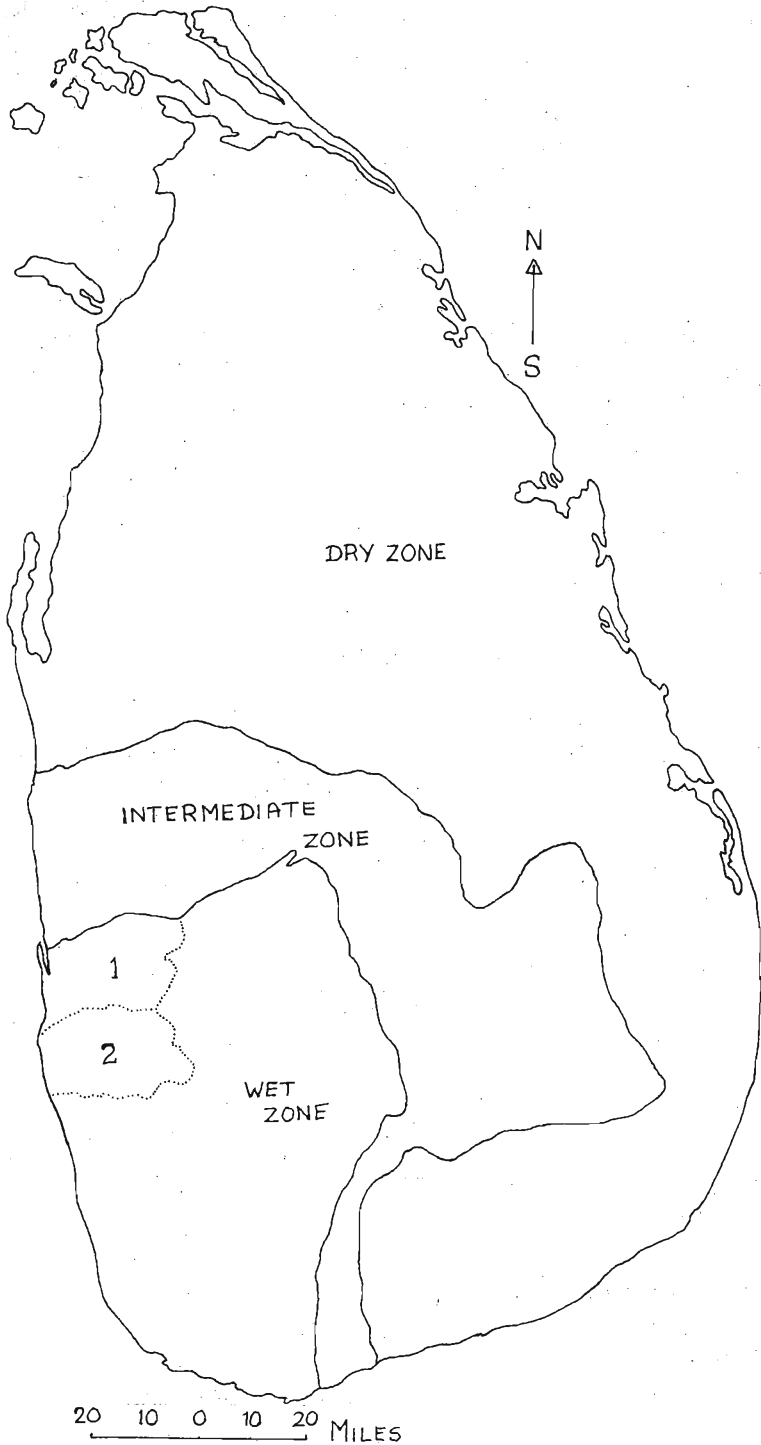


Figure 1. A Map of Sri Lanka indicating the Wet, Intermediate and Dry Zones and the Gampaha (1) and Colombo (2) districts.

main emphasis was to record and assess the weed flora within fields/liyaddes and their bunds, some weeds frequently found associated with the network of irrigation ditches (canals) were also recorded. Weed specimens were collected as vouchers for preservation, as well as for confirmation of identity. Wherever possible the farmers who had cultivated the sampled rice-fields were interviewed regarding the major weed problems they had, and the present status of such weeds.

The number of villages from each district where sampled rice-fields were located depended on the proportion of land cultivated with rice. For the 1984 Yala season when the survey was undertaken, 116 villages from the Gampaha district and 46 villages from the Colombo district were chosen by the Department of Census and Statistics for crop-yield estimations, as well by the author for the rice-weed survey. However, heavy monsoonal rains which occurred in May–June 1984 destroyed a large number of fields which had been sown. This reduced the number villages surveyed in the present work to 88 from the Gampaha district (176 fields) and 40 from the Colombo district (80 fields).

3. Results and Discussion

Table 1 provides a comprehensive list of the species of rice-field weeds found in the two districts. The major families to which the commonest rice-field weeds belong were: Gramineae (29 spp.), Cyperaceae (31 spp.) and Scrophulariaceae (12 spp.). The families Asteraceae (7 spp.), Leguminosae (9 spp.) and Onagraceae (4 spp.) were also well represented within the rice-field habitats, and on the bunds.

Table 1. Floristic composition of rice-field weeds in Gampaha and Colombo districts, indicating their occurrence and major habitat in the rice-agroecosystem (Yala season, 1984).

Taxon & Family	Occurrence ^a	Major Habitat ^b
1. ACANTHACEAE		
<i>Asteracantha longifolia</i> (L.) Nees	occasional	B
<i>Hygrophylla salicifolia</i> (Vahl) Nees	occasional	B
2. AIZOACEAE		
<i>Mollugo oppositifolia</i> L.	occasional	B

Taxon & Family	Occurrence ^a	Major Habitat ^b
3. AMARANTHACEAE		
<i>Alternanthera sessilis</i> (L.) DC.	frequent	B,F
4. BUTOMACEAE		
<i>Limnocharis flava</i> (L.) Buchen.	widespread	F,B,D
5. CERATOPHYLLACEAE		
<i>Ceratophyllum demersum</i> L.	occasional	F,B
6. COMMELINACEAE		
<i>Commelina benghalensis</i> L.	frequent	B
<i>Commelina diffusa</i> Burm. f.	widespread	B,F,D
7. COMPOSITAE (ASTERACEAE)		
<i>Ageratum conyzoides</i> L.	frequent	B
<i>Eclipta prostrata</i> (L.) L.	widespread	B,F
<i>Epaltes divaricata</i> (L.) Cass.	occasional	B
<i>Sphaeranthus africanus</i> L.	frequent	B,F
<i>Sphaeranthus indicus</i> L.	frequent	B,F
<i>Spilanthes paniculata</i> Wall. ex DC.	occasional	B
<i>Vernonia cinerea</i> (L.) Less	widespread	B,D
8. CONVULVULACEAE		
<i>Ipomoea aquatica</i> Forsk.	frequent	B,D
<i>Ipomoea triloba</i> L.	frequent	B,F
9. CYPERACEAE		
<i>Cyperus compressus</i> L.	frequent	B
<i>Cyperus difformis</i> L.	occasional	F,B
<i>Cyperus haspan</i> L.	widespread	F,B,D
<i>Cyperus iria</i> L.	widespread	F,B,D
<i>Cyperus pilosus</i> Vahl	widespread	F,B,D
<i>Cyperus procerus</i> Rottb.	frequent	B
<i>Cyperus sphecelatus</i> Rottb.	frequent	B
<i>Eleocharis dulcis</i> (Burm. f.) Trin ex. Hensch	widespread	F
<i>Fimbristylis acuminata</i> Vahl	widespread	B,F
<i>Fimbristylis dichotoma</i> (L.) Vahl	widespread	B,F
<i>Fimbristylis ferruginea</i> (L.) Vahl	widespread	B
<i>Fimbristylis umbellaris</i> (Lam.) Vahl	occasional	B,F

Taxon & Family	Occurrence ^a	Major Habitat ^b
<i>Fimbristylis miliacea</i> (L.) Vahl	widespread	F,B,D
<i>Fimbristylis schoenoides</i> (Retz.) Vahl	widespread	B,F
<i>Fimbristylis tetragona</i> R. Br.	widespread	B,F,D
<i>Fuirena ciliaris</i> (L.) Roxb.	occasional	B,F
<i>Fuirena umbellata</i> Rottb.	widespread	F,B
<i>Fuirena capitata</i> (Burm.f.) T. Koyama	widespread	B,F
<i>Kyllinga brevifolia</i> Rottb.	widespread	B,F,D
<i>Kyllinga melanosperma</i> Nees	occasional	B,D
<i>Kyllinga nemoralis</i> (J.R. & G. Forst.) Dandy ex Hutchinson & Dalziel	occasional	B,D
<i>Kyllinga bulbosa</i> Rottb.	widespread	B
<i>Mariscus paniceus</i> (Rottb.) Vahl	occasional	B
<i>Pycneus polystachyos</i> (Rottb) Beauv.	frequent	B
<i>Pycneus pumilus</i> (L.) Nees	occasional	B
<i>Rhynchospora corymbosa</i> (L.) Britton	occasional	B,D,F
<i>Schoenoplectus articulatus</i> (L.) Palla	occasional	F
<i>Schoenoplectus juncoides</i> (Roxb.) Palla	widespread	F,B,D
<i>Schoenoplectus grossus</i> (L.f.) Palla	frequent	F,B,D
<i>Scleria poaeformis</i> Retz.	occasional	B,F
<i>Scleria sumatrensis</i> Retz.	occasional	B
10. ERIOCAULACEAE		
<i>Eriocaulon quinquangulare</i> L.	widespread	F
<i>Eriocaulon sexangulare</i> L.	widespread	F
<i>Eriocaulon thwaitzii</i> Koern.	frequent	F
11. EUPHORBIACEAE		
<i>Euphorbia birta</i> L.	frequent	B
<i>Phyllanthus debilis</i> Klein ex Willd.	frequent	F,B
<i>Phyllanthus urinaria</i> L.	frequent	B
12. FABACEAE (LEGUMINOSAE)		
<i>Aeschynomene aspera</i> L.	frequent	F,B
<i>Aeschynomene indica</i> L.	frequent	F,B
<i>Alysicarpus vaginalis</i> DC.	frequent	B
<i>Cassia tora</i> L.	occasional	B
<i>Desmodium heterocarpum</i> (L.) DC.	frequent	B,D
<i>Desmodium heterophyllum</i> (Willd.) DC.	frequent	B,D
<i>Desmodium triflorum</i> (L.) DC.	frequent	B,D
<i>Mimosa pudica</i> L.	widespread	B
<i>Tephrosia purpurea</i> (L.) Pers.	occasional	B

Taxon & Family	Occurrence ^a	Major Habitat ^b
13. GRAMINEAE (POACEAE)		
<i>Alloteropsis cimicina</i> (L.) Stapf	frequent	B
<i>Axonopus affinis</i> Chase	widespread	B,D
<i>Axonopus compressus</i> (Sw.) Beauv.	frequent	B,D
<i>Coix gigantea</i> Koen. ex Roxb.	occasional	F,B
<i>Echinochloa colonum</i> (L.) Link.	widespread	F,B,D
<i>Echinochloa crus-galli</i> (L.) Beauv.	widespread	F,B
<i>Echinochloa frumentacea</i> Link.	frequent	F,B
<i>Echinochloa stagnina</i> (Retz.) Beauv.	frequent	F,B
<i>Eleusine indica</i> (L.) Gaertn.	widespread	B,D
<i>Eragrostis gangetica</i> (Roxb.) Steud.	frequent	B,D
<i>Eragrostis tenella</i> (L.) Beauv. ex Roem & Schult	occasional	B
<i>Eragrostis unioides</i> (Retz.) Nees ex Steud.	widespread	B,F
<i>Isachne globosa</i> (Thunb.) Kuntze	widespread	F,B,D
<i>Isachne miliacea</i> Roth ex Roem. & Schult	occasional	B
<i>Ischaemum indicum</i> (Houtt.) Merr.	frequent	B
<i>Ischaemum muticum</i> L.	occasional	B,D
<i>Ischaemum rugosum</i> Salisb.	widespread	F,B
<i>Leersia hexandra</i> Sw.	frequent	B,D,F
<i>Leptochloa chinensis</i> (L.) Nees	frequent	B,D
<i>Oryza perennis</i> Moench	occasional	F
<i>Oryza rufipogon</i> Griff.	frequent	F,B
<i>Panicum brevifolium</i> L.	occasional	B,F
<i>Panicum repens</i> (L.) Beauv.	widespread	B,F,D
<i>Paspalum commersonii</i> Lam.	widespread	B,F
<i>Paspalum conjugatum</i> Berg.	widespread	B
<i>Sacciolepis indica</i> (L.) Chase	widespread	B,F
<i>Sacciolepis interrupta</i> (Willd.) Stapf	widespread	F,B
<i>Setaria geniculata</i> (Lam.) Beauv.	frequent	B,F
<i>Sporobolus diandrus</i> (Retz.) Beauv.	frequent	B
14. HYDROCHARITACEAE		
<i>Blyxa octandra</i> (Roxb.) Planch. ex Thw.	occasional	D,F
<i>Ottelia alismoides</i> (L.) Pers.	occasional	D,F
15. HYDROPHYLLACEAE		
<i>Hydrolea zeylanica</i> (L.) Vahl	occasional	F

Taxon & Family	Occurrence ^a	Major Habitat ^b
16. LAMIACEAE (LABIATAE)		
<i>Hyptis capitata</i> Jacq.	occasional	B
<i>Hyptis suaveolens</i> (L.) Poit.	frequent	B
<i>Leucas zeylanica</i> (L.) R. Br.	widespread	B
17. LENTIBULARIACEAE		
<i>Utricularia bifida</i> L.	frequent	F
<i>Utricularia reticulata</i> Sm.	frequent	F
18. LOBELIACEAE		
<i>Lobelia alsinoides</i> Lam.	occasional	F
19. LYTHRACEAE		
<i>Rotala densiflora</i> (Roth ex Roem. & Schult.) Koehne	frequent	F
20. MARSILIACEAE		
<i>Marsilea quadrifolia</i> L.	frequent	F,D
21. ONAGRACEAE		
<i>Ludwigia adscendens</i> (L.) Hara	occasional	F,D
<i>Ludwigia</i> spp. (<i>decurrens</i> Walt.?)	widespread	F,B
<i>Ludwigia hyssopifolia</i> (G. Don) Exell	widespread	F,B
<i>Ludwigia perennis</i> L.	occasional	F,B
22. POLYGONACEAE		
<i>Polygonum barbatum</i> L.	frequent	B,D
<i>Polygonum glabrum</i> Willd.	occasional	B,D
23. PONTEDERIACEAE		
<i>Monochoria vaginalis</i> (Burm. f.) Kunth	widespread	F,D,B
24. RUBIACEAE		
<i>Hedyotis auricularia</i> L.	widespread	B
<i>Knoxia zeylanica</i> L.	frequent	B
<i>Mitracarpus hirtus</i> (L.) DC.	frequent	B
<i>Oldenlandia corymbosa</i> L.	frequent	B
<i>Spermacoce hispida</i> L.	widespread	B
<i>Spermacoce latifolia</i> Aubl.	widespread	B,F

Taxon & Family	Occurrence ^a	Major Habitat ^b
25. SCROPHULARIACEAE		
<i>Bacopa monnieri</i> (L.) Pennell	frequent	F,B
<i>Dopatrium junceum</i> (Roxb.) Buch-Ham. ex Benth.	widespread	F
<i>Dopatrium lobelioides</i> (Retz.) Benth.	widespread	F
<i>Limnophila aquatica</i> (Roxb.) Alston	frequent	F,D
<i>Limnophila aromatica</i> (Lam.) Merr.	occasional	F,D
<i>Limnophila repens</i> (Benth.) Benth.	widespread	F,B,D
<i>Lindernia anagallis</i> (Burm.f.) Pennell	widespread	F,B
<i>Lindernia antipoda</i> (L.) Alston	frequent	F,B
<i>Lindernia byssopioides</i> (L.) Haines	widespread	F,B,D
<i>Lindernia pusilla</i> (Willd.) Boldingh.	frequent	B
<i>Lindernia rotundifolia</i> (L.) Alston	widespread	F,B,D
<i>Scoparia dulcis</i> L.	widespread	B
26. SALVINIACEAE		
<i>Azolla pinnata</i> Lam.	occasional	F,D
<i>Salvinia molesta</i> D.S. Mitchell	widespread	F,D
27. STERCULIACEAE		
<i>Melochia corchorifolia</i> L.	widespread	B,F
28. TILIACEAE		
<i>Corchorus olitorius</i> L.	frequent	B,F
<i>Triumfetta rhomboidea</i> Jacq.	frequent	B
29. XYRIDACEAE		
<i>Xyris indica</i> L.	frequent	F,D

^awidespread = most common and widely distributed; frequent = less common, yet frequently found also with wide distribution; occasional = least common, patchy in appearance.

^bB = Bund; D = Ditch (irrigation canal); F = Field

3.1 Monocotyledonous Weeds

Table 2 gives the occurrence of the commonest monocotyledonous species in the two districts and their levels of infestation. Species have been listed in the order of abundance. In general, the relative abundance of the major weed species found in the two districts was not dissimilar.

In both districts *Fimbristylis miliacea* was the most frequently recorded monocotyledonous weed, found growing in 96.5% of fields sampled in Gampaha and in 97.5% of fields in Colombo. Where it occurred, 38.7% of its infestations were at the level of 3 or above, indicating its seriousness as a weed. However, this major weed completed its life-cycle within the first 3–4 months and often before the rice crop matured. Hence, by the time of harvesting the rice, this weed may not be very conspicuous, as it would be earlier on in the growing season.

Isachne globosa was the second most frequent weed. In the Colombo district its occurrence was as high as that of *F. miliacea*, but in Gampaha it occurred at a lower frequency. However, this grass-weed notably had a greater proportion of the heaviest infestations with scores of 3 or above being given to 48.6% of fields where it occurred.

Two species of the sedge genus *Cyperus*, namely *Cyperus iria* L. and *Cyperus pilosus* Vahl, were the third and fourth ranking monocotyledonous weeds in the two districts, *Cyperus iria* occurred in 82% of fields sampled in Gampaha and 88% of fields in Colombo, while the figures for *C. pilosus* were 70% and 98% respectively for the two districts. Like *F. miliacea*, *C. iria* was also found most conspicuously in the early part of the growing season. This weed too completed its life-cycle usually before the rice crop matured, and was not prominent at later stages. *Cyperus pilosus*, on the other hand, was found to persist longer and also to display noticeable variation with respect to dimensions of leaves, size and colour of inflorescence, etc., as noted by Koyama.⁵

Echinochloa colonum (L.) Link. and *Echinochloa crus-galli* (L.) Beauv. were both found to be major weeds in the rice-fields surveyed. The former occurred in 68% of fields sampled in Gampaha and 56% of fields in Colombo. *Echinochloa crus-galli* was recorded from 63% of fields in Gampaha and in 49% of fields in the Colombo district. Infestations of both weeds were moderate to heavy in the two districts (Table 2).

Monochoria vaginalis (Burm. f.) Kunth occurred in 64% and 59% of fields in Gampaha and Colombo districts, respectively. Although these infestations were less severe than those of the above, (scores of 1 and 2 in 90% of fields where it occurred), *M. vaginalis* too appeared to be a major weed in

Table 2. The Relative abundance at five levels of the most frequent monocotyledonous weeds in 256 rice-fields of the Gampaha and Colombo districts (1984)

Taxon	Relative abundance					Total fields infested	Frequency of occurrence	Frequency of occurrence in Gampaha	Frequency of occurrence in Colombo	
	0	1	2	3	4					5
1. <i>Fimbristylis miliacea</i>	8	13	139	82	14	—	248	96.9	96.5	97.5
2. <i>Isachne globosa</i>	38	21	91	67	35	4	218	85.2	79.5	97.5
3. <i>Cyperus iria</i>	40	58	109	38	11	—	216	84.4	82.3	88.7
4. <i>Cyperus pilosus</i>	56	57	107	33	3	—	200	78.1	69.9	97.5
5. <i>Echinochloa colonum</i>	90	43	95	21	7	—	166	64.8	68.2	56.3
6. <i>Monochoria vaginalis</i>	95	52	94	15	—	—	161	62.9	64.7	58.8
7. <i>Echinochloa crus-galli</i>	106	25	74	38	13	—	150	58.6	63.1	48.8
8. <i>Cyperus haspan</i>	117	47	76	16	—	—	139	54.3	54.0	55.0
9. <i>Ischaemum rugosum</i>	119	24	54	37	20	2	137	53.5	47.7	66.3
10. <i>Commelina diffusa</i>	127	71	53	5	—	—	129	50.4	47.7	56.3
11. <i>Eriocaulon sexangulare</i>	134	30	76	16	—	—	122	47.7	50.0	42.5
12. <i>Scirpus juncoides</i>	177	7	59	13	—	—	79	30.9	28.4	36.3
13. <i>Limnochloa flava</i>	190	15	40	11	—	—	66	25.8	19.3	40.0
14. <i>Fimbristylis tetragona</i>	216	4	28	8	—	—	40	15.6	9.1	30.0

0 = weed species not observed; 1 = a few plants; 2 = occasional patches; 3 = weed widespread throughout field; 4 = dense and severe infestation; 5 = weed completely dominant and masking crop.

Gampaha district — out of 176 fields sampled.

Colombo district — out of 80 fields sampled.

both districts, particularly in the fields fed by irrigation waters.

Cyperus haspan, a species recorded earlier¹⁰ to be one of the first three major weeds in an all-island survey, occurred only in 54% of fields sampled in the two districts. Its occurrence in the two districts was not much dissimilar, and their infestations were also relatively less severe (Table 2).

The occurrence of *Ischaemum rugosum* Salisb. in the rice-fields is worthy of special mention. Although this grass weed was the 9th most frequent when both districts were considered, its position in the Colombo district was found to be of a higher ranking. It occurred in 66% of sampled fields in Colombo and was ranked fifth in order of abundance. In Gampaha it occurred in 47% of fields. In both districts the infestations were fairly heavy. Infestation levels of 3, 4 or 5 were recorded from 64% of fields where it occurred in Colombo, while in Gampaha such heavy infestations were found in 30% of fields infested with the weed (data not presented). The farmer interviews revealed that *I. rugosum* is a species that appears to be rapidly becoming a major threat to rice cultivation. According to most farmers this weed has already achieved a greater prominence than *Cyperus*, *Isachne*, *Fimbristylis* or *Echinochloa* species in terms of a need for weed control. Many expressed the view that *I. rugosum* was not considered so important 10–20 years ago, suggesting that its present abundance may have been achieved over a relatively short period of time.

Among other monocotyledonous species found in the rice-fields of the two districts, the following also occurred at fairly high frequency: *Commelina diffusa* Burm. f., *Eriocaulon sexangulare* L., *Scirpus juncoides* Roxb., *Limnocharis flava* (L.) Buchen., *Fimbristylis tetragona* R.Br., *Fimbristylis dichotoma* (L.) Vahl, *Eleocharis dulcis* (Burm.f.) Trin. ex Hensch., *Paspalum commersonii* Link., *Sacciolepis indica* (L.) Chase and *Kyllinga brevifolia* Rottb.

3.2 Dicotyledonous Weeds

The occurrence of the most frequent dicotyledonous weeds in the rice-fields sampled and their levels of infestation are given in Table 3. Fifty-two dicotyledonous weed species were recorded from the rice-fields in the present survey. However, only a few species were recorded as of high infestation levels and abundance.

Ludwigia hyssopifolia (G. Don) Exell was by far the most frequently recorded dicotyledonous weed. Its occurrence in the two districts was very similar. All fields sampled in the Colombo district (100%) and 92% of fields in the Gampaha district had this weed. Infestations of *L. hyssopifolia* were also found to be heavy with scores of 3 or higher recorded for 37% of fields

Table 3. The Relative abundance at five levels of the most frequent dicotyledonous weeds in 256 rice fields of the Gampaha and Colombo districts (1984)

Taxon	Relative abundance					Total fields infested	Frequency of occurrence	Frequency of occurrence		
	0	1	2	3	4			5	in Gampaha	in Colombo
1. <i>Ludwigia byssopifolia</i>	13	35	119	77	12	—	243	94.9	92.6	100.00
2. <i>Lindernia anagallis</i>	58	41	119	38	—	—	198	77.3	78.4	75.0
3. <i>Lindernia byssopioides</i>	64	40	110	42	—	—	192	75.0	81.3	61.3
4. <i>Lindernia rotundifolia</i>	71	42	105	38	—	—	185	72.3	79.1	59.4
5. <i>Dopatrium lobelioides</i>	141	38	70	7	—	—	115	44.9	42.5	39.1
6. <i>Eclipta prostrata</i>	147	53	55	1	—	—	109	42.6	45.5	36.3
7. <i>Ludwigia decurrens</i>	172	14	39	22	9	—	84	32.8	10.2	82.5

0 = weed species not observed; 1 = a few plants; 2 = occasional patches; 3 = weed widespread throughout field; 4 = a dense and severe infestation; 5 = weed completely dominant and masking crop.

Gampaha District — out of 176 fields sampled.

Colombo District — out of 80 fields sampled.

in which it was recorded from both districts. A second species of *Ludwigia*, tentatively identified as *Ludwigia decurrens* Walt. *, a species which had not been previously recorded from Sri Lanka,³ was also found to occur very commonly, particularly in the Colombo district. It was recorded from the Gampaha district in only about 10% of fields sampled, thus indicating a major difference in the geographical distribution of the weed. Where it occurred in the Colombo district, infestation levels were high with scores of 3 or higher being recorded for 45% of the sampled fields (data not presented).

Three species of *Lindernia*, namely *Lindernia anagallis* (Burm. f.) Pennell, *Lindernia hyssopioides* (L.) Haines and *Lindernia rotundifolia* Alston, were found at high frequency in both districts. However, these infestations were in general less severe than those of the *Ludwigia hyssopifolia* (Table 3).

Other common dicotyledonous weeds found growing in the rice-fields of the two districts included the following: *Dopatrium lobelioides* (Retz.) Benth., *Dopatrium junceum* (Roxb.) Ham., *Eclipta prostrata* (L.) L., *Limnophila repens* (Benth.) Benth., *Limnophila aquatica* (Roxb.) Alston, *Lindernia pusilla* (Willd.) Boldingh., and *Utricularia reticulata* Smith.

The distribution of the most frequent dicotyledonous weeds in the two districts was found to be wide and generally uniform, except in the case of the second species of *Ludwigia* stated earlier. In the Colombo district this weed was found to be regarded as troublesome, but it was clear from the farmer interviews that they made very little distinction between the unidentified* *Ludwigia* spp. and the more widespread *L. hyssopifolia*. The farmer interviews also revealed that apart from the *Ludwigia* species, dicotyledonous weeds cause very little concern to them.

3.3 Weed Flora of Rice-field bunds

The weeds found on the rice-field bunds were mainly a fair number of the semi-aquatic species recorded from within the fields and other species which were more terrestrial in nature (Table 4).

The commonest monocotyledonous weeds found on the bunds were: *Isachne globosa*, *Eragrostis unioides* (Retz.) Nees ex Steud, *Fimbristylis miliacea*, *Cyperus pilosus*, *Panicum repens* L., *Commelina diffusa*, *Paspalum commersonii* and *Cyperus iria*.

The occurrence of *E. unioides* and *P. repens* was limited to the bund habitat only and their infestations were heavy with scores of 3 or above

*This plant species is in the process of being recorded by the author as a new species for Sri Lanka, in a later issue of the J. Natn. Sci. Coun. Sri Lanka.

Table 4. The Relative abundance at five levels of the most frequent monocotyledonous and dicotyledonous weeds on the bunds of 256 rice-fields in the Gampaha and Colombo districts (1984)

Taxon	Relative abundance					Total fields infested	Frequency of occurrence	Frequency of occurrence		
	0	1	2	3	4			5	in Gampaha	in Colombo
1. <i>Isachne globosa</i>	2	9	77	94	74	—	254	98.8	98.6	100.00
2. <i>Eragrostis uniolooides</i>	7	17	86	101	45	—	249	97.3	95.5	100.00
3. <i>Ludwigia byssopifolia</i>	19	20	167	45	5	—	237	92.6	89.2	100.00
4. <i>Fimbristylis miliacea</i>	29	28	137	56	6	—	227	88.7	87.0	92.6
5. <i>Cyperus pilosus</i>	35	52	149	20	—	—	221	86.3	81.9	96.1
6. <i>Panicum repens</i>	59	33	73	59	32	—	197	76.9	76.7	88.0
7. <i>Commelina diffusa</i>	62	13	99	77	5	—	194	75.8	84.7	56.3
8. <i>Paspalum commersonii</i>	79	21	115	40	1	—	177	69.1	70.6	65.0
9. <i>Cyperus iria</i>	86	64	94	11	1	—	170	66.4	63.7	73.8
10. <i>Echinochloa colonum</i>	97	62	63	34	—	—	159	58.2	73.8	36.2
11. <i>Lindernia anagallis</i>	133	56	62	5	—	—	123	48.1	36.4	73.8
12. <i>Spermacoce latifolia</i>	135	19	78	24	—	—	121	47.3	48.9	43.8
13. <i>Lindernia rotundifolia</i>	136	37	64	19	—	—	120	47.1	43.5	49.2
14. <i>Eclipta prostrata</i>	141	58	49	8	—	—	115	44.9	42.6	50.0
15. <i>Sacciolepis indica</i>	144	22	79	11	—	—	112	43.7	30.1	73.8
16. <i>Kyllinga brevifolia</i>	146	19	79	12	—	—	110	42.9	43.8	41.3
17. <i>Scoparia dulcis</i>	160	32	60	4	—	—	96	37.5	42.1	26.3
18. <i>Pycnopus polystachyos</i>	173	36	44	3	—	—	83	32.5	34.1	28.8
19. <i>Azonus affinis</i>	179	5	44	23	5	—	77	30.1	29.8	31.3

0 = weed species not observed; 1 = a few plants; 2 = occasional patches; 3 = weed widespread throughout field; 4 = a dense and severe infestation; 5 = weed completely dominant and masking crop.

Gampaha District - out of 176 fields sampled
 Colombo District - out of 80 fields sampled

recorded for 58.6% and 46.2% of fields where they occurred, respectively. *Isachne globosa* was the most frequent weed found on bunds in both districts (Table 4) and its infestations were usually heavy with scores of 3 or higher being given to 65.6% of fields in which the weed occurred in both districts. Other monocotyledonous species found at high frequency on the bunds included: *Echinochloa colonum*, *Ischaemum rugosum*, *Ischaemum muticum* L. (*Schaemum indicum* Houtt.) Merr., *Sacciolepis indica*, *Kyllinga brevifolia*, *Pycreus polystachyos* (Rottb.)* Beauv. and *Axonopus affinis* Chase.

Several dicotyledonous semi-aquatics were also commonly found as potential weeds on the bunds. *Ludwigia hyssopifolia* was the major dicotyledonous weed found growing on bunds, and was recorded from 92.6% of sampled fields. Infestations of *L. hyssopifolia* on bunds were usually heavy with scores of 3 or higher being given to 21% of fields in which it occurred. *Lindernia* spp., *Eclipta prostrata*, *Scoparia dulcis* L., *Alternanthera sessilis* (L.) DC., *Leucas zeylanica* (L.) R.Br., *Hedyotis auricularia* L. and *Sphaerathus indicus* L. were common dicotyledonous semi-aquatic weeds found on the bunds.

In addition, many cosmopolitan and terrestrial weeds were also recorded from the bund habitat. These appeared to have spread to the rice-fields from nearby habitats, roadsides and home-gardens. Such species included: *Ageratum conyzoides* L., *Vernonia cinerea* (L.) Less., *Euphorbia hirta* L., *Desmodium heterocarpum* (L.) DC., *Desmodium triflorum* (L.) DC., *Desmodium heterophyllum* (Willd.) DC., *Alysicarpus vaginalis* DC., *Mitracarpus hirtus* (L.) DC., *Spermacoce latifolia* Aubl., *Knoxia zeylanica* L., *Hyptis suaveolens* (L.) Poit., *Melochia corchorifolia* L. and *Triumfetta rhomboidea* Jacq.

4. Conclusions

It was evident from the survey data that monocotyledonous weeds constitute the major rice-field weeds in the two districts studied. Presently they appear to be the most frequent and widespread. *Fimbristylis miliacea*, *Isachne globosa* and *Cyperus iria* were the most abundant rice-field weeds both in terms of frequency of occurrence and levels of infestation. *Ludwigia hyssopifolia* emerged as the biggest dicotyledonous weed problem which plagues rice-fields in the two districts studied. A second species of *Ludwigia* whose identity is yet to be confirmed, was found to occur at high frequency mainly in the Colombo district and spreading rapidly, threatening to become a major weed soon. Many other dicotyledonous weeds occurred in the sampled rice-fields, but these did not pose a major threat to rice culture, requiring control measures. In general, a very rich weed flora was found in

the fields studied, occurring within the field habitat and on the raised earthen bunds, composed mainly of semi-aquatic and terrestrial plant species.

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